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(54) Data broadcast receiver for use with a computer

(57) Broadcast data inputted from a terminal 1 is decoded by a tuner 10, and audio/video signals and digital data are separated by a demultiplexer 11. The audio/video signals are converted to analog signals by an A/V decoder 16 and outputted from a terminal 4. The digital data stream is reconstructed from a TS (Transport Stream) packet to an IP (Internet Protocol) packet by a packetizer 12, and an IP address allocated to the data receiving device on the broadcast network on the basis of an address conversion table 13a, obtained in advance, is converted to an IP address allocated to a personal computer on the Internet (via the data receiving device). The reconstructed IP packet is outputted to the personal computer through a LAN interface 14 selected by a routing section 13. An accounting control section 17 is provided, if necessary, for accounting control in receiving chargeable data.

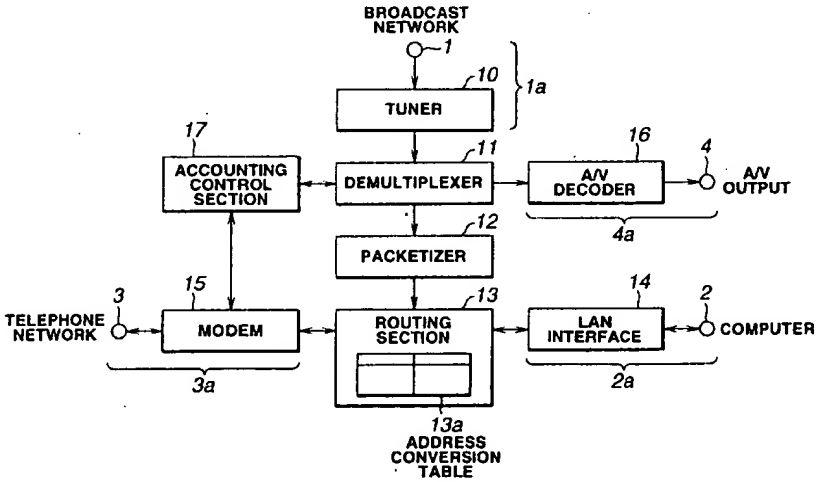

FIG.2

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Description

This invention relates to a data receiving device and a data receiving method for outputting received digital data to a computer. In an illustrative embodiment, the data is received via, for example, a digital satellite broadcast network.

A receiving device capable of receiving only broadcast streams of audio data and video data and outputting audio/video streams from an external interface is generally used, such as a receiving device for cable television broadcast or satellite broadcast.

Some of such receiving devices have a function to receive digital data which is to be utilized on a computer, in addition to the video/audio streams, and may output the data streams to the computer from an output port. However, no such receiving devices have a function to output the received broadcast data as an IP (Internet Protocol) data gram.

In order to utilize the data received through a broadcast network on a computer, it is necessary to mount a dedicated circuit board on each computer. Therefore, the receiving device is lacking in versatility and is not necessarily easy to handle.

Illustrative embodiments of the present invention seek to provide a data receiving device and a data receiving method which enable conversion of digital data transmitted through a broadcast network into an IP data gram and output of the IP data gram to a computer or the like.

According to the present invention, there is provided a data receiving device for receiving broadcast data including digital data and outputting the broadcast data to a computer. The data receiving device includes a first interface to which the broadcast data is inputted, a packetizer for reconstructing the inputted broadcast data into a predetermined packet, and a second interface for outputting the reconstructed packet to the computer.

According to the present invention, there is also provided a data receiving method for receiving broadcast data including digital data and outputting the broadcast data to a computer. The data receiving method includes a packetizing step of reconstructing inputted broadcast data into a predetermined protocol packet, and a routing step of rewriting header information and controlling a route of response data with respect to the protocol packet, in outputting the reconstructed predetermined packet to the computer.

According to the present invention, a data receiving device and a data receiving method for converting data transmitted through a broadcast network into IP data and outputting the IP data to a computer may be provided.

For a better understanding of the present invention reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a view showing an illustrative data receiving device according to the present invention;

Figure 2 is a schematic block diagram of the illustrative data receiving device;

Figures 3A and 3B are views for explaining the flow of data in the illustrative data receiving device;

Figure 4 is a view for explaining the process of producing an IP packet;

Figure 5 is a view showing the detailed structure of an IP header;

Figure 6 is a detailed block diagram showing an illustrative example of a data receiving device according to the present invention;

Figure 7 is a view of an example of a front panel of a data receiving device according to the present invention;

Figure 8 is a view of another example of a front panel of the data receiving device according to the present invention;

Figure 9 is a view showing still another example of a front panel of a data receiving device according to the present invention; and

Figure 10 is a view showing an example of a back panel of a data receiving device according to the present invention.

Preferred embodiments of the present invention will now be described in detail with reference to the drawings.

Figure 1 shows an illustrative embodiment of a data receiving device of the present invention.

This data receiving device has a function to receive digital data which is utilized on a computer, in addition to the functions of an ordinary broadcast receiving device for receiving video data and audio data streams and outputting the received data streams. This data receiving device also has an external output interface for outputting digital data streams of received video data and audio data.

Specifically, a data receiving device 101 has a broadcast interface 1a for connection to a broadcast network through a coaxial cable or the like, a PC interface 2a for connection to a personal computer 20 through a LAN (Local Area Network), a telephone interface 3a for connection to an external network such as the Internet through a telephone network, and an AV equipment interface 4a for outputting received A/V (Audio/Video) data.

This data receiving device 101 is characterized in that the above-described interfaces are housed in a single casing to realize a compact structure, unlike a conventional device in which the interfaces are laid out on a circuit board mounted on an extended slot of the computer 20. Therefore, simply by installing the data receiving device 101 between the computer 20 and the broadcast network or the telephone network and connecting a connector, the data transmitted through the broadcast network may be converted to IP data so as to be utilized on the computer 20.

Figure is a block diagram of an illustrative data receiving device of the present invention.

The basic function of this data receiving device is to receive digital data transmitted through a unidirectional circuit of large capacity such as a satellite broadcast network and outputting the received digital data to the computer. Therefore, this data receiving device has the following three interfaces.

The broadcast interface 1a as a first interface is a broadcast interface connected to the broadcast network through a coaxial cable at a terminal 1. The broadcast interface la includes a tuner 10 for receiving digital satellite broadcast or cable television broadcast.

The broadcast network to be connected is not limited to the satellite broadcast or cable television broadcast, and may be a broadcast network using ground waves.

The PC interface 2a as a second interface is a computer interface for transmitting/receiving data to/from the personal computer via a terminal 2. Normally, the PC interface 2a includes a LAN interface for connection to the computer through the LAN. The LAN assumed in this case is based on 10BaseT for carrying out base band transmission at a transmission speed of 10 Mbps, or the IEEE 1394 Standard for a High Performance Serial Bus which enables mixed transmission of control signals and information signals at a transfer speed of 100 M/200 M/400 Mbps, as a serial interface standard.

The telephone interface 3a as a third interface is an external connection interface for connection to an external network such as the Internet. As the telephone network, a PSTN (Public Switched Telephone Network) for transmitting analog audio signals in a frequency band of 3.4 kHz, or an ISDN (Integrated Services Digital Network) for transmitting digital data at 64 to 128 kbps is used. These telephone networks are connected to a terminal 3 through a modem or a terminal adaptor of the ISDN.

This data receiving device may include only the broadcast interface 1a and the PC interface 2a, depending on the required functions. Also, an ATM (Asynchronous Transfer Mode) or an FDDI (Fiber Distributed Data Interface) may be used other than the above-described interfaces.

The tuner 10 selects a desired broadcast channel from broadcast data inputted through the terminal 1, and outputs the data stream thereof. This data stream includes digital data to be utilized on the computer as well as audio data and video data.

A demultiplexer 11 collects and classifies packets having the same PID (Packet Identifier) of the packets of data steams selected by the tuner 10. Thus, the audio data, the video data and the digital data as multiplexed broadcast data are separated from one another.

The separated audio data and video data are transmitted to an A/V decoder 16, and the digital data is transmitted to a packetizer 12, as later described.

The A/V decoder 16 is adapted for decoding the video data stream and the audio data stream from the demultiplexer 11 into analog signals. The analog signals are outputted from an A/V output terminal 4.

The data receiving device will be described further in detail with reference to the flow of the digital data separated by the demultiplexer 11.

In the following description, it is assumed that a personal computer connected through the PC interface 2a is connected a service provider of the Internet through the telephone interface 3a. An IP (Internet Protocol) address is allocated to each of the interfaces, and the data stream is an IP data gram.

As described above, the digital data stream separated by the demultiplexer 11 is transmitted to the packetizer 12. This packetizer 12 is adapted for converting the unit or format of a transport stream packet, for example, in conformity to the transmission standard of digital satellite broadcast, and generating a predetermined packet based on the Internet Protocol, for example.

In this case, a TS (Transport Stream) packet from the demultiplexer 11 is reconstructed into an IP (Internet Protocol) packet and transmitted to a routing section 13. The IP packet as a set of data is also referred to as an IP data gram.

The routing section 13 is adapted for selecting a route of data to be handled on the data receiving device, and converting the address of the destination in accordance with the selected route. The routing section 13 selects the route between the broadcast interface 1a, the PC interface 2a and the telephone interface 3a. The control information may be included in the broadcast data inputted through the broadcast interface 1a, or may be included in the data transmitted from the personal computer connected through the PC interface 2a.

A LAN interface 14 is an interface for transmitting/receiving data to/from the personal computer connected through the terminal 2, and is an interface for connection to a LAN.

A modem 15 is an interface for transmitting/receiving data to/from an external network through the telephone network connected to the terminal 3. When the telephone network is an ISDN, a terminal adaptor is used separately.

An accounting control section 17 is adapted for controlling accounting in receiving a chargeable broadcast program. Such control is referred to as CA (Conditional Access) control. The accounting control section 17 is provided, if necessary. This accounting control section 17 has a function to transmit accounting information generated in accordance with the conditions recorded on a memory card, to a broadcasting service provider through the telephone network.

In the above description, the broadcast data inputted to the data receiving device is not scrambled. However, it is normal that actual broadcast data is scrambled. In this case, a descrambler for audio/video data is provided after the tuner 10, and a descrambler for data is provided after the packetizer 12.

The operation of the data receiving device having the above-described basic structure will now be described with reference to Fig.3.

First, transmission and reception of an IP data gram between the personal computer and an external Internet connection provider through the data receiving device will be described.

The IP data gram received through the terminal 2 and the LAN interface 14 constituting the PC interface 2a is transmitted to the routing section 13. When this IP data gram is to be transmitted to the telephone network, the telephone interface 3a is selected and the data is transmitted to the modem 15. The modem 15 calls the Internet connection provider through the telephone network connected to the terminal 3, and transmits the IP data gram to the telephone network from the terminal 3 on completion of connecting operation.

The data transmitted from the Internet connection provider through the telephone network is inputted to the routing section 13 via the modem 15 from the terminal 3. At this point, the PC interface 2a is selected and the received data is outputted to the computer.

As the communication protocol in outputting the IP data gram through the PC interface 2a from the routing section 13, the standard Internet Protocol is used. This data receiving device obtains the IP address allocated in advance to each receiving device (personal computer) in the process of PPP (Point-to-Point Protocol) connection to the Internet connection provider. In addition, after obtaining the IP address, the data receiving device accesses an authentication server on the Internet managed by the digital satellite broadcasting service provider, and obtains the IP address allocated to each receiving device used on the broadcast network. The corresponding relation between the IP address on the Internet and the IP address on the broadcast network is stored in a memory (RAM) as an address conversion table 13a within the routing section 13.

In the following description of data, a bidirectional telephone network is used in transmitting a request to the external network such as the Internet from the computer, and data from the Internet in response to the request is received by using a unidirectional broadcast network of large capacity such as a digital satellite broadcast network or a cable television network.

As shown in Fig.3A, the request from the personal computer is transmitted to the routing section 13 through the PC interface 2a. At this point, the routing section 13 rewrites the IP data address of the header portion of the IP data gram to the IP address of the broadcast interface 1a on the basis of the address conversion table 13a. Then, the IP data gram with the rewritten IP address is processed by recalculation of check sum and then transmitted to the Internet through the telephone network from the modem 15. The rewritten IP address pair is stored on the address conversion table 13a. That is, the address conversion table 13a shows the corresponding relation between the IP address used on the broadcast network and the IP address used normally on the Internet.

By thus carrying out address conversion, the data transmitted from the server of the Internet is passed through the broadcast network such as the digital satellite broadcast network, and received by the personal computer through the broadcast interface 1a, the demultiplexer 11, the packetizer 12, the routing section 13 and the PC interface 2a of the data receiving device, as shown in Fig.3B. Specifically, the transport stream packet received by the tuner 10 through the broadcast interface 1a is converted to the IP packet by the packetizer 12 and transmitted to the routing section 13. The IP destination address, allocated on the broadcast network, of the header portion of the IP data gram as a set of IP packets is rewritten to the IP address of the computer that made the request for the corresponding data. Then, the PC interface 2a is selected and the IP data gram is transmitted to the personal computer.

The bidirectional communication using the broadcast interface 1a of the data receiving device may be realized not only by the above-described method using address rewrite, but also by various other methods.

The IP packet will now be described.

Fig.4 shows the structure of an IP packet.

The size of an IP packet 60 is prescribed by the TCP/IP (Transmission Control Protocol/Internet Protocol). If data requested by a user exceeds the prescribed size, the data is divided into plural IP packets.

In the case where data is to be encrypted, it is normal that encryption is carried out with respect to a plaintext of 64 bits. If the data length of the IP packet 60 to be encrypted is not a multiple of 64 bits, padding of invalid data is carried out to make the entire IP packet 60 a multiple of 64 bits, thus forming an IP packet 61.

To an IP packet 62 formed by encrypting the IP packet 61 for a specified user, a MAC header 70 is appended. This MAC header 70 includes a SSID (Server System ID) of 8 bits, a UDB (User Depend Block) 1 of 24 bits, and a UDB2 of 32 bits. Particularly, in the UDB2 of the MAC header 70, a destination IP address similar to the destination IP address written in the IP header is written.

The destination IP address in the IP header is encrypted, and therefore cannot be known on the side of the receiving device unless it is decoded. However, as the same destination IP address exists in the MAC header 70, the receiving side can find whether the data block is directed to the user or not, simply by reading the destination IP address in the MAC header 70 in a hardware manner.

In the UDB1, a PBL (Padding_Byte_Length) of 3 bits, a CP (Control_Packet) of 1 bit, an EN (Encrypted_or_Not) of 1 bit, a PN (Protocol_Type Available_or_Not) of 1 bit, a Reserve of 2 bits, and a protocol number (Protocol Type) of 16 bits are set.

The PBL is the padding byte length and expresses the length of invalid data padded in encryption. The PBL

is necessary so that the user receiving the encrypted IP packet can know the normal data length.

The CP is a bit for identifying whether data required by the user or control data necessary for system operation exists in the IP packet or not. Normally, the CP of a MAC frame 63 to be received when the user makes a request indicates that not control data but data exists.

The EN is a control bit indicating whether or not the IP packet is encrypted by an encryptor. In accordance with this bit information, the user determines whether to decode the received MAC frame 63 or not. The PN is a control bit indicating whether or not useful information exists in the protocol type area. The control bits are appended to the IP packet 62.

In the UDB2, a contents ID expressing the type of information of the IP packet may also be set in addition to the destination IP address. The contents ID will be described later. The SSID identifies whether the destination IP address or the contents ID is set in the UDB2.

A CRC (Cyclic Redundancy Checking) is appended to the MAC frame 63. By thus carrying out calculation of the CRC on the data transmitting side, the data receiving side can check whether the received MAC frame is correctly transmitted or not. The generated CRC of 16 bits is appended to the last portion of the MAC frame 63.

The MAC frame 63 is converted to a section prescribed by the MPEG2, for example. The MAC frame 63 is appended immediately after a section (Sec) header 71, thus forming a section referred to as a private section 64.

The private section 64 to be transmitted is divided into transport packets 651, 652, ... 65n.

Figure 5 shows the IP header of the IP packet 60 used in this case. In this IP header, a destination IP address 74 of the user and a transmitter IP address 73 are set. The destination IP address 74 has 32 bits.

A data receiving device according to an embodiment of the present invention will now be described further in detail.

Figure 6 is a detailed block diagram of an example of a data receiving device according to the present invention.

Data transmitted through the broadcast network in response to a request from a specified user is received at a receiving antenna 31 on the user side and transferred to the data receiving device of the specified user.

A signal received at the receiving antenna 31 is converted to an IF signal and inputted to a data receiving device 32 from a terminal 1. In the data receiving device 32, the signal is converted to a digital signal through a tuner 33, an A/D converter 34, a demodulator 35 and a decoder 36. The operation of the demodulator 35 and the decoder 36 is controlled by a micro computer 51 under the command of a CPU 42.

Then, encrypted TS packet data processed by demodulation and error correction is transmitted to a descrambler 37.

The descrambler 37 carried out descrambling on a TS packet level with respect to the encrypted TS packet data. In this case, the descrambler 37 reads the value of a PID portion and a scramble control portion from the header portion of the encrypted TS packet data, and judges whether or not a TS packet decoding key corresponding to this value is provided by the service provider. If the decoding key is provided, the descrambler 37 decodes a payload portion of the encrypted TS packet by using the decoding key, and outputs the decoded TS packet. If the decoding key is not provided, the descrambler 37 cancels the encrypted TS packet.

The decoded TS packet is supplied to a demultiplexer 38. The demultiplexer 38 divides audio data and video data multiplexed together with the TS packet data. Then, the demultiplexer 38 supplies the audio data to an audio decoder 39 and supplies the video data to a video decoder 40. The audio decoder 39 outputs an analog audio signal from an audio output terminal 4a, and the video decoder 40 outputs an analog video signal from a video output terminal 4b via an NTSC encoder 41. The remaining TS packet data is supplied to a packetizer 45.

The packetizer 45 is adapted for reconstructing the TS packet from the demultiplexer 38 into an IP (Internet Protocol) packet. The IP packet (IP data gram) reconstructed by the packetizer 45 is transmitted to a routing section 47 via a data descrambler 46. The data descrambler 46 is adapted for carrying out descrambling in the case where the IP data gram is scrambled. The decoding key in this operation is housed within a dual port RAM (DPRAM) 48, corresponding to an identifier.

The routing section 47 is means for selecting whether to output the IP data gram to a computer through a LAN interface 49 or to transmit the IP data gram to an external network connected to a telephone network through a modem 54. This operation is controlled by the CPU 42 as control means.

The CPU 42 is control means for controlling the operation of this data receiving device. Specifically, the CPU 42 controls reading of the DPRAM 48 and setting of the value of a reference table. The CPU 42 also controls the demultiplexer 38 and the DPRAM 48 in accordance with a program read into a RAM 43 from a ROM 44. The CPU 42 also controls transmission of the request to the external network through the modem 54 and the telephone network. These control operations are carried out through a host bus 55.

In addition, the CPU 42 may process data read from an IC card reader 53 so as to generate the decoding key or accounting information, if necessary.

Finally, the shape of an illustrative data receiving device according to the present invention will be described.

This data receiving device is housed in the box-like casing, as described above, and has the broadcast interface for connection to the broadcast network, the computer interface for connection to the LAN, and the

external connection interface for connection to the telephone network, on the back side thereof. The data receiving device also has a broadcast receiving function similar to that of a generally commercialized broadcast transmitting/receiving device.

Figure 7 shows an example of the structure of front panel of the data receiving device.

On the front panel, indicators for indicating operating states are provided. In this example, a power indicator 80 for indicating the on-off state of a power source, a link indicator 85 for indicating the link state, and a collision indicator 87 for indicating that collision of data is detected are provided.

Fig.8 shows another example of the structure of the front panel of the data receiving device.

In this example, a B1 indicator 81 a B2 indicator 82, a Tx (transmission) indicator 83, an Rx (receiving) indicator 84, and an analog indicator 86 are provided in addition to the indicators shown in Fig.7.

Fig.9 shows still another example of the structure of the front panel of the data receiving device. In this example, the power indicator 80, the Tx indicator 83, the Rx indicator 84, the link indicator 85, the analog indicator 86, and the collision indicator 87 are provided.

Fig. 10 shows an example of the structure of a back panel of the data receiving device.

On the back panel, a tuner interface (tuner I/F) connector 91 for connecting the broadcast network and the tuner, a network interface (network I/F) connector 92 for connecting the computer through the LAN or the like, and a telephone interface (telephone I/F) connector 93 for connection to the telephone network through a modem are provided. These connectors 91, 92, 93 correspond to the terminals 1, 2, 3, respectively.

In addition, audio R/L output connectors 94A, 94B for outputting analog audio signals, video output connectors 95A, 95B for outputting analog video signals, and S video output connectors 96A, 96B for outputting S video signals are provided. A power connector 100 is adapted for supplying power to this data receiving device.

According to an embodiment of the present invention, data transmitted through a broadcast network is received and converted to an IP packet which can be uniformly processed on a personal computer, and the IP packet is outputted. Therefore, the data transmitted through the broadcast network may be utilized on the computer in response to a request from a personal computer of each user through a telephone network. Also, since an IP address allocated on the Internet and an IP address allocated on the broadcast network are automatically converted, the user can access the Internet without being aware of the difference between these IP addresses.

In addition, means for realizing the above-mentioned functions is compactly housed in a single casing, and all the necessary interfaces are provided. Therefore, a data receiving device having high versatility may be provided without being affected by limitations such as the type of computer. By using this data receiving device, a unidirectional circuit of large capacity such as a digital satellite broadcast network may be easily used in down-loading a large volume of data at a high speed from an external network such as the Internet.

Claims

1. A data receiving device for receiving broadcast data including digital data and outputting the received broadcast data to a computer, the device comprising:

   a first interface to which the broadcast data is inputted;
   a packetizer for reconstructing the inputted broadcast data into a predetermined packet; and
   a second interface for outputting the reconstructed packet to the computer.

2. The data receiving device as claimed in claim 1, wherein the broadcast data is inputted through a satellite broadcast network or a cable television network.

3. The data receiving device as claimed in claim 1, wherein the reconstructed predetermined packet is an Internet Protocol packet.

4. The data receiving device as claimed in claim 1, wherein the second interface is an interface for connection to a local area network, and the reconstructed packet is outputted to the computer through the local area network.

5. The data receiving device as claimed in claim 1, wherein the second interface is based on the IEEE 1394 Standard for a High Performance Serial Bus.

6. The data receiving device as claimed in claim 1, further comprising a third interface for connection to a telephone network, and routing means for selecting a route between the first interface, the second interface and the third interface in accordance with the contents of the received broadcast data.

7. The data receiving device as claimed in claim 6, further comprising control means for controlling the routing means in accordance with the received broadcast data.

8. The data receiving device as claimed in claim 6, wherein the routing means has an address conversion table for converting an address allocated on the broadcast network to an address allocated on

the Internet.

9. A data receiving method for receiving broadcast data including digital data and outputting the received broadcast data to a computer, the method comprising:

a packetizing step of reconstructing inputted broadcast data into a predetermined protocol packet; and

a routing step of rewriting header information and controlling a route of response data with respect to the protocol packet, in outputting the reconstructed predetermined packet to the computer.

10. The data receiving method as claimed in claim 9, wherein the broadcast data is inputted through a satellite broadcast network or a cable television network.

11. The data receiving method as claimed in claim 9, wherein the reconstructed predetermined packet is an Internet Protocol packet.

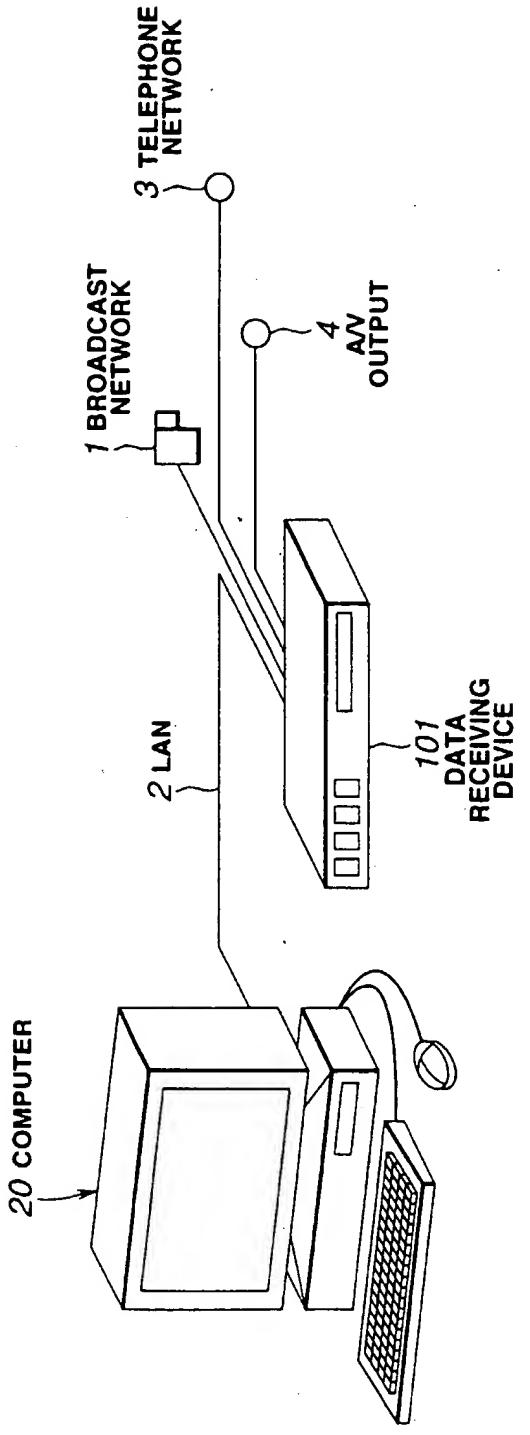

3 TELEPHONE NETWORK
1 BROADCAST NETWORK
4 A/V OUTPUT
2 LAN
101 DATA RECEIVING DEVICE
20 COMPUTER

FIG.1

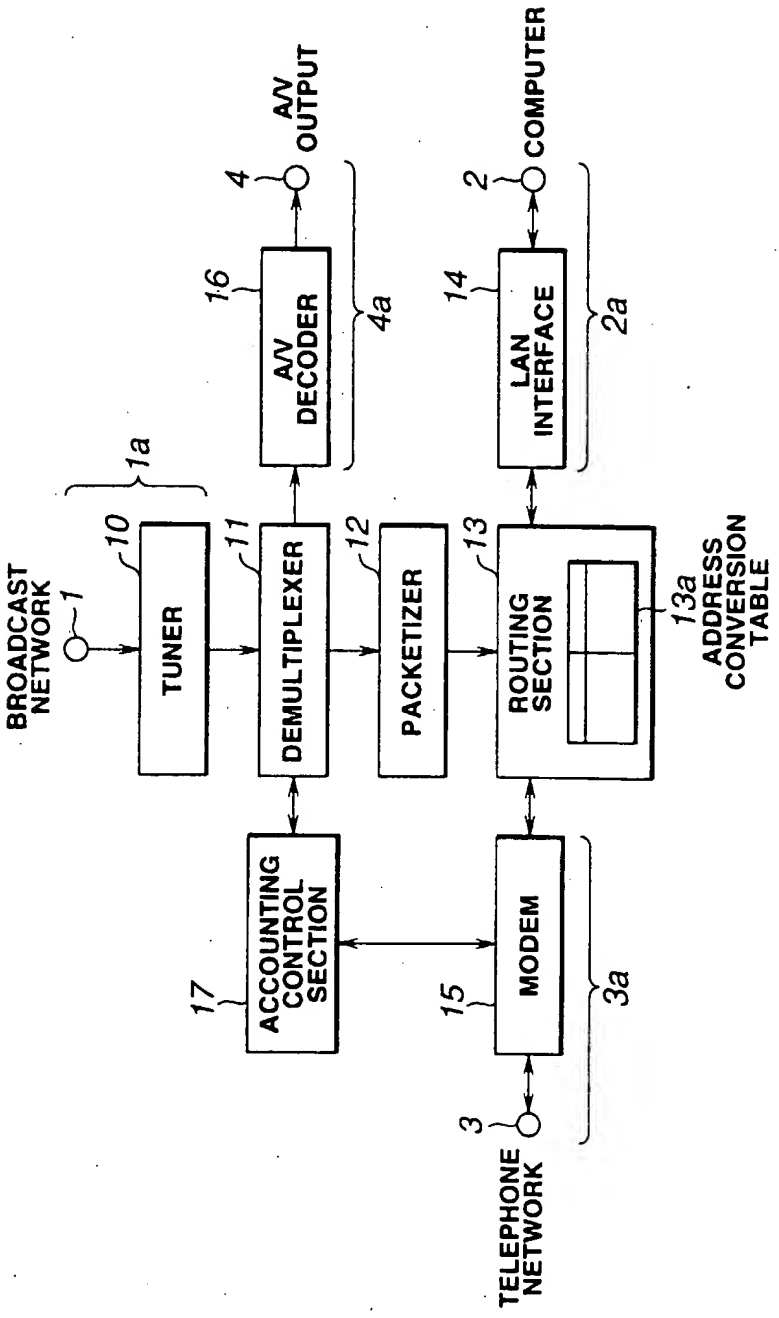

BROADCAST NETWORK
1
TUNER
10
1a
DEMULTIPLEXER
11
PACKETIZER
12
ROUTING SECTION
13
13a
ADDRESS CONVERSION TABLE
A/V DECODER
16
4a
4
A/V OUTPUT
LAN INTERFACE
14
2a
2
COMPUTER
ACCOUNTING CONTROL SECTION
17
MODEM
15
3a
3
TELEPHONE NETWORK

FIG.2

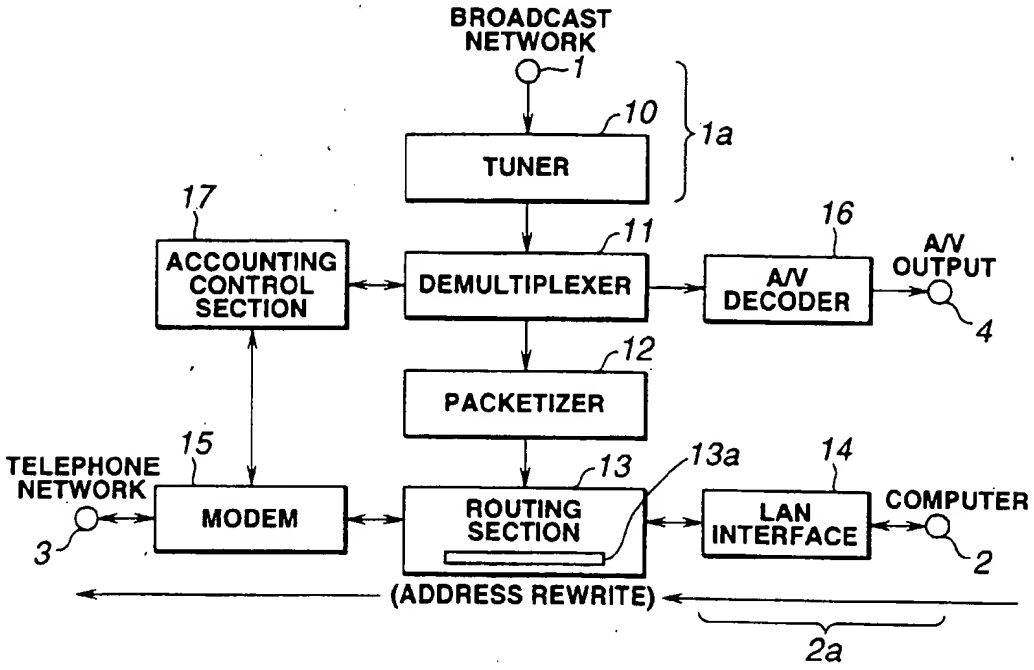
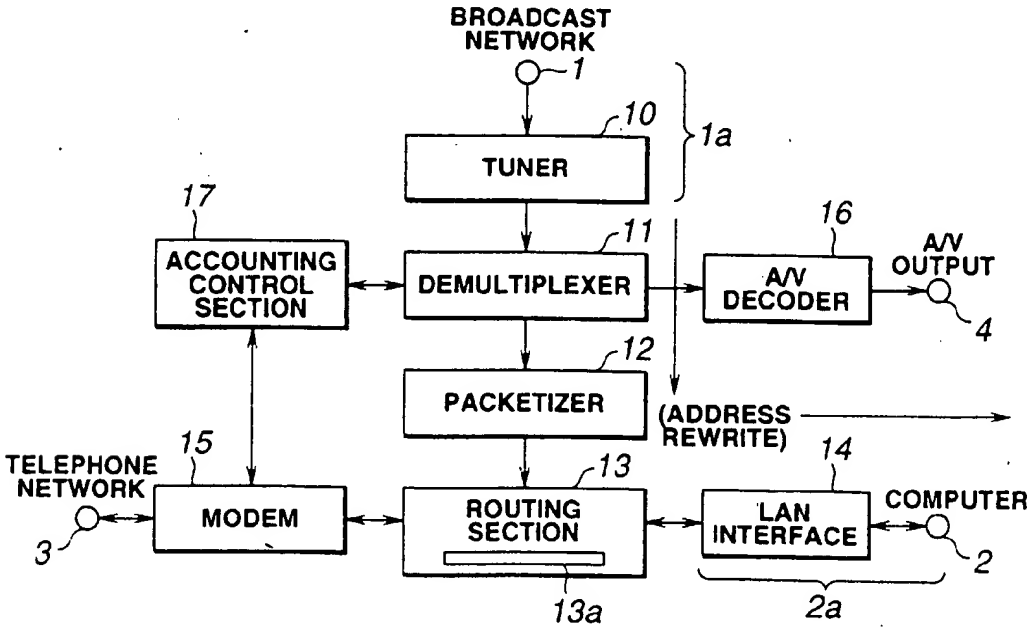

BROADCAST NETWORK
1
10
1a
TUNER
17
ACCOUNTING CONTROL SECTION
11
DEMULTIPLEXER
16
A/V DECODER
A/V OUTPUT
4
12
PACKETIZER
TELEPHONE NETWORK
15
MODEM
3
13
13a
ROUTING SECTION
14
LAN INTERFACE
COMPUTER
2
(ADDRESS REWRITE)
2a

FIG.3A


BROADCAST NETWORK
1
10
1a
TUNER
17
ACCOUNTING CONTROL SECTION
11
DEMULTIPLEXER
16
A/V DECODER
A/V OUTPUT
4
12
PACKETIZER
(ADDRESS REWRITE)
TELEPHONE NETWORK
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MODEM
3
13
ROUTING SECTION
14
LAN INTERFACE
COMPUTER
2
13a
2a

FIG.3B

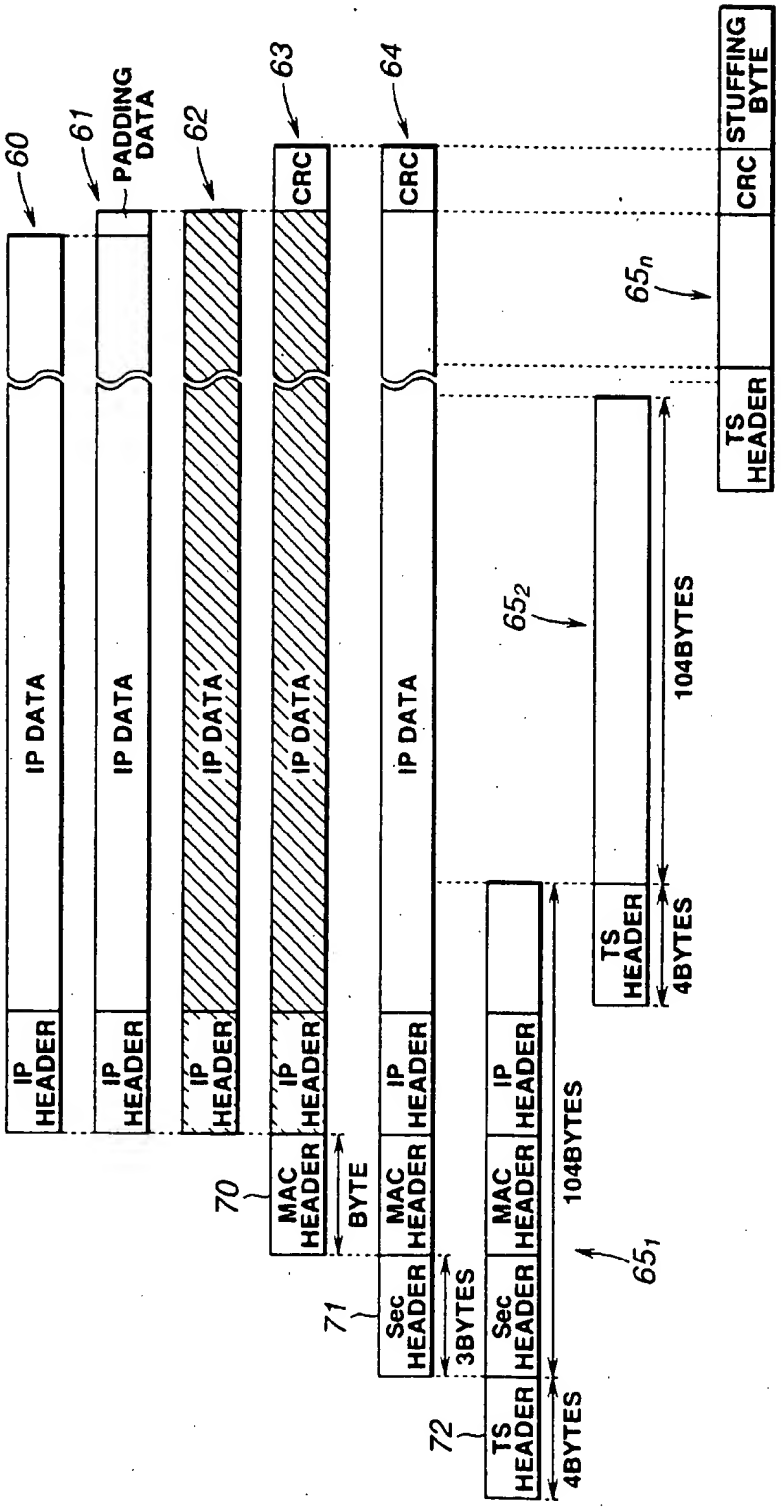
60
61
PADDING DATA
62
63
64
CRC
STUFFING BYTE
IP HEADER
IP DATA
TS HEADER
65_n
65_2
104BYTES
4BYTES
70
MAC HEADER
BYTE
71
Sec HEADER
3BYTES
72
65_1

FIG.4

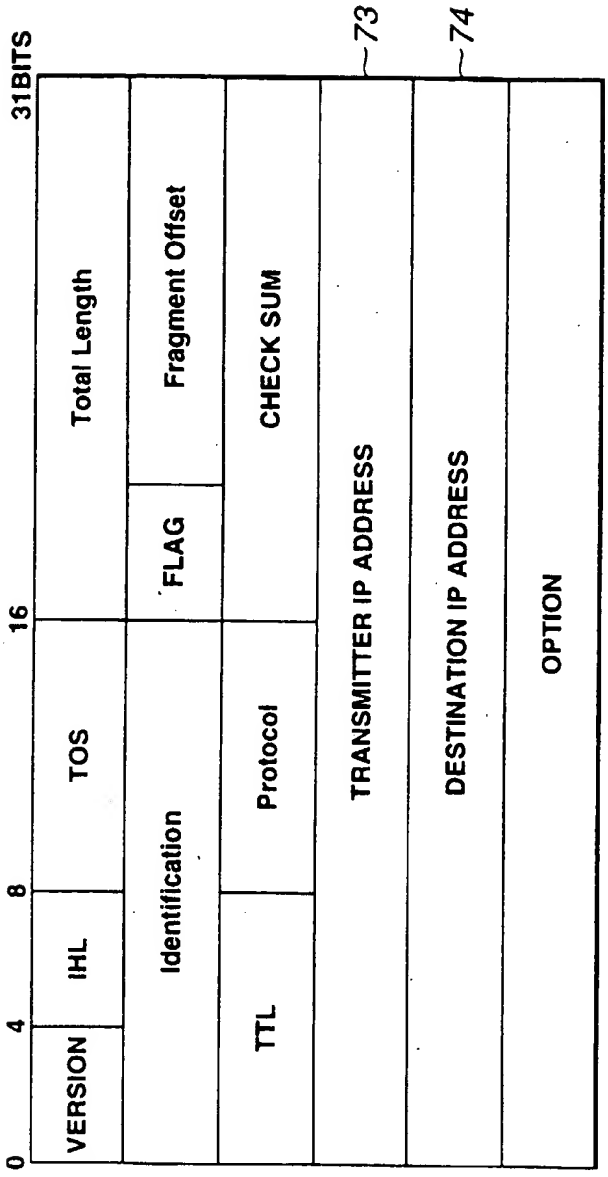
0
4
8
16
31BITS
VERSION
IHL
TOS
Total Length
Identification
FLAG
Fragment Offset
TTL
Protocol
CHECK SUM
TRANSMITTER IP ADDRESS
DESTINATION IP ADDRESS
OPTION
73
74

FIG.5

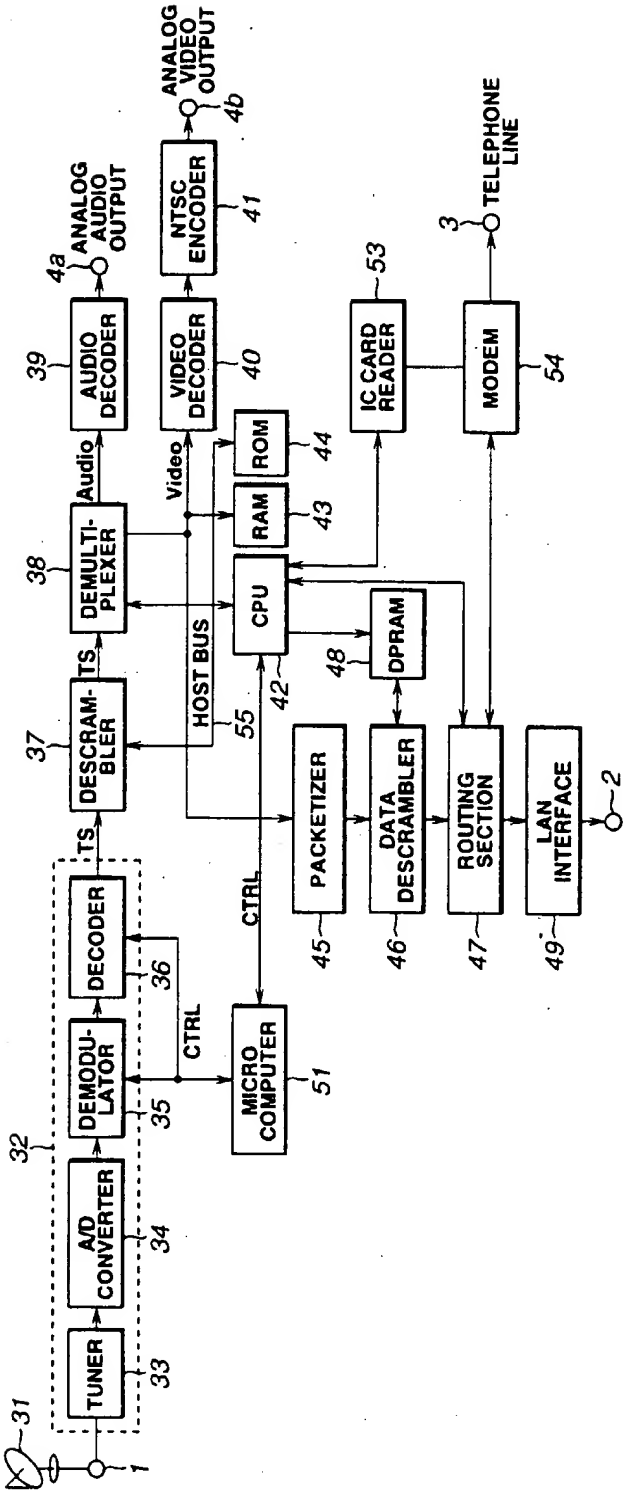
ANALOG VIDEO OUTPUT
4b
NTSC ENCODER
41
ANALOG AUDIO OUTPUT
4a
AUDIO DECODER
39
VIDEO DECODER
40
TELEPHONE LINE
3
IC CARD READER
53
MODEM
54
ROM
44
RAM
43
Audio
Video
DEMULTI-PLEXER
38
CPU
42
DPRAM
48
HOST BUS
55
TS
DESCRAM-BLER
37
PACKETIZER
45
DATA DESCRAMBLER
46
ROUTING SECTION
47
LAN INTERFACE
49
2
TS
DECODER
36
CTRL
CTRL
MICRO COMPUTER
51
DEMODU-LATOR
35
A/D CONVERTER
34
TUNER
33
32
31
1

FIG.6

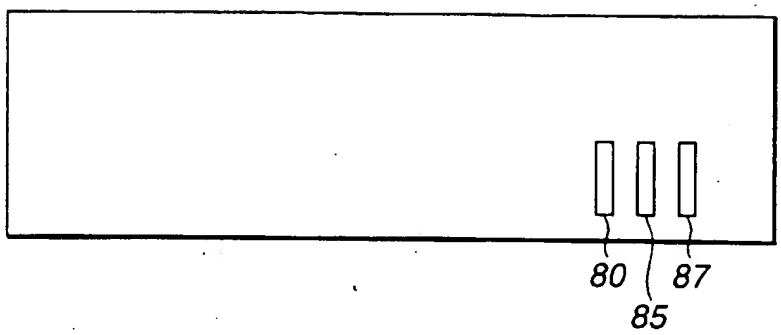

FIG.7

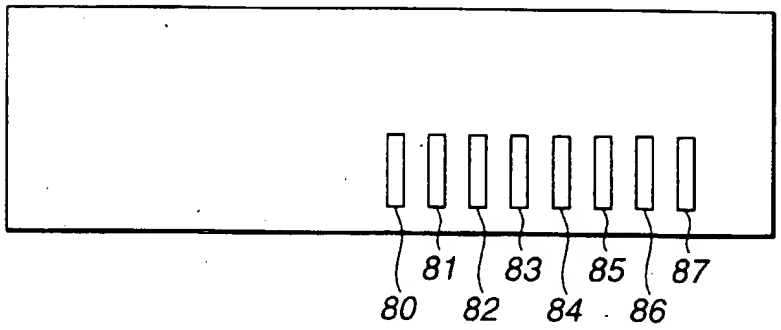

FIG.8

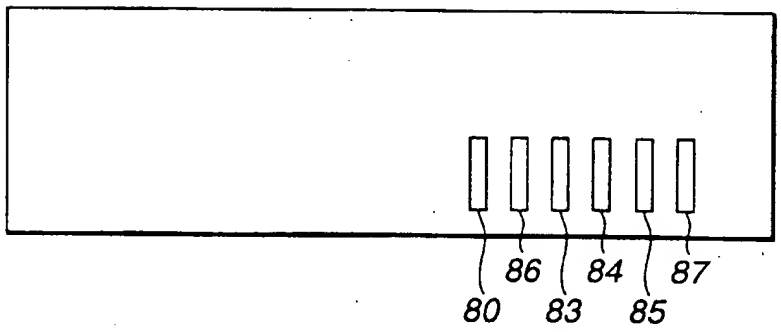

FIG.9

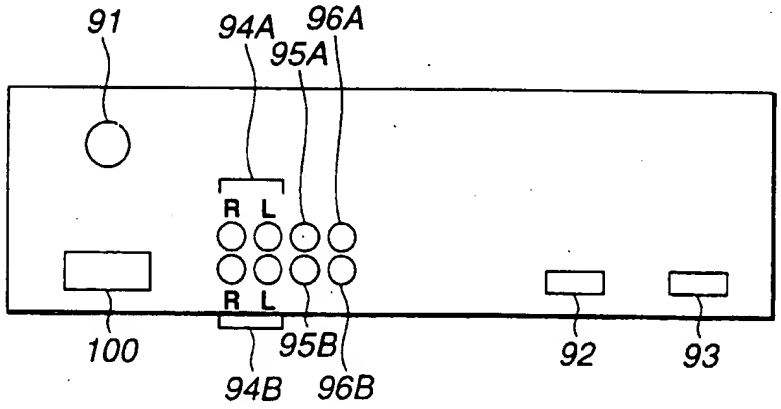

FIG.10